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**Date: 10/04/2004**

**Access Control Interlock System (ACIS)**  
**Interface Control Document**  
**for the**  
**Generation-3**  
**Personnel Safety System**  
**(PSS)**  
**of the**  
**Advanced Photon Source**  
**at**  
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**WBS X.1.4.1.4**

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	<b>Title: Access Control Interlock System (ACIS) Interface Control Document</b>		<b>Rev. 00</b>	<b>Approved</b>	<b>Date 10/04/2004</b>
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## 1. INTRODUCTION


### 1.1. SYSTEM PURPOSE

This Chain-A input/output listing contains the hardwired addresses for the Allen Bradley Control Logix PLC. This listing will be utilized for software design and development of the Personnel Safety System (PSS).

### 1.2. DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

The following are some of the frequently appearing or unique acronyms used in this document. This list is provided as a quick reference for the reader's convenience.

ACIS	Access Control Interlock System
APS	Advanced Photon Source
ASD	Accelerator Systems Division
BLEPS	Beam Line Equipment Protection System
CPU	Central Processing Unit
C&C	Command and Control
DIW	De-Ionized Water
DOE	Department Of Energy
EPICS	Experimental Physics and Industrial Control System
EPS	Equipment Protection System
ES&H	Environment, Safety & Health Manual
ESD	Emergency Shut Down
FEEPS	Front End Equipment Protection System
FOE	First Optics Enclosure
I/O	Input Output
IOC	Input Output Controller (data collection for EPICS)
LAN	Local Area Network
OI	Operator Interface
PSS	Personnel Safety System
PLC(s)	Programmable Logic Controller(es)
PMD	Programmable Message Display
SAD	Safety Assessment Document
SDD	Software Design Document
SyRS	System Requirements Specification
TBD	To Be Defined/Decided
VME	Versa Module Euro card
XFD	Experimental Facilities Division

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### 1.3. REFERENCES

#### Government Documents

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

Department of Energy (DOE) ORDER 420.2A, 01-08-01  
Accelerator Safety Implementation Guide for DOE O 420.2A, Draft, August 2001  
DOE ORDER 5480.25, 11-3-92  
DOE GUIDANCE 5480.25, September 1, 1993

DOE ORDER and GUIDANCE 5480.25 are included because they were in effect and referenced when the Safety Assessment Document (SAD) was originally written; it has been superseded by DOE ORDER 420.2, which has been superseded by DOE ORDER 420.2A. DOE ORDER 420.2(A) essentially made the approved SAD the effective regulatory document.

Copies of specifications, standards, drawings and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting office.

#### Non-Government Documents

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.  
Environment Safety & Health Manual, Section 5.16 (ES&H 5.16) April 25, 2003, Argonne National Laboratory.  
APS Safety Assessment Document (SAD), Rev 1, May 1999, Argonne National Laboratory, Argonne, IL.

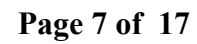
Compliance with the following required by SAD:


Stanford Linear Accelerator Center Report 327 (SLAC 327), April 1988, Stanford Linear Accelerator Center, Menlo Park, CA.

National Council on Radiation Protection Report No. 88 (NCRP 88), Issued 30 December 1986, National Council on Radiation Protection.

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

Document No. 1111-00001-00 APS Quality Assurance Plan, dated May 1990.


[illegible]

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## 1.5. NOTES & EXCEPTIONS

All Input Signals are High True unless otherwise noted.



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## 2. SCOPE

This document describes the interface between the Storage Rings Access Control and Interlock System and the beam line Personnel Protection Systems for “new builds” starting in May 2004 and Version 3 PSSs..

## 3. APPLICABLE DOCUMENTS

### 3.1. APS DOCUMENTS

Document No. APS 3.1.2.1.0 Rev 1 Safety Assessment Document, May 1998

Document No. [2001-017](#) RF Area ACIS Design Specification, November 2001

Document No. [2001-018](#) Storage Ring ACIS Design Specification, November 2001

### 3.2. DRAWINGS

ACIS Drawing No. 13153-00000832 Storage Ring ACIS – Bending Magnet Beam Line Shutter Interface

ACIS Drawing No. 13153-00000833 Storage Ring ACIS – Insertion Device Beam Line Shutter Interface

ACIS Drawing No. 13153-00000834 Storage Ring ACIS – PSS Global Key, Shutter Permit, and PSS Storage Ring Permit Interface


PSS Drawing No.31502-836302 Front End Photon Shutter 1 Cross Connect Enclosure

PSS Drawing No. 31502-837302 Front End Photon Shutter 2 Cross Connect Enclosure

PSS Drawing No.31502-838302 Front End Safety Shutter 1 Cross Connect Enclosure

PSS Drawing No. 31502-839302 Front End Safety Shutter 2 Cross Connect Enclosure

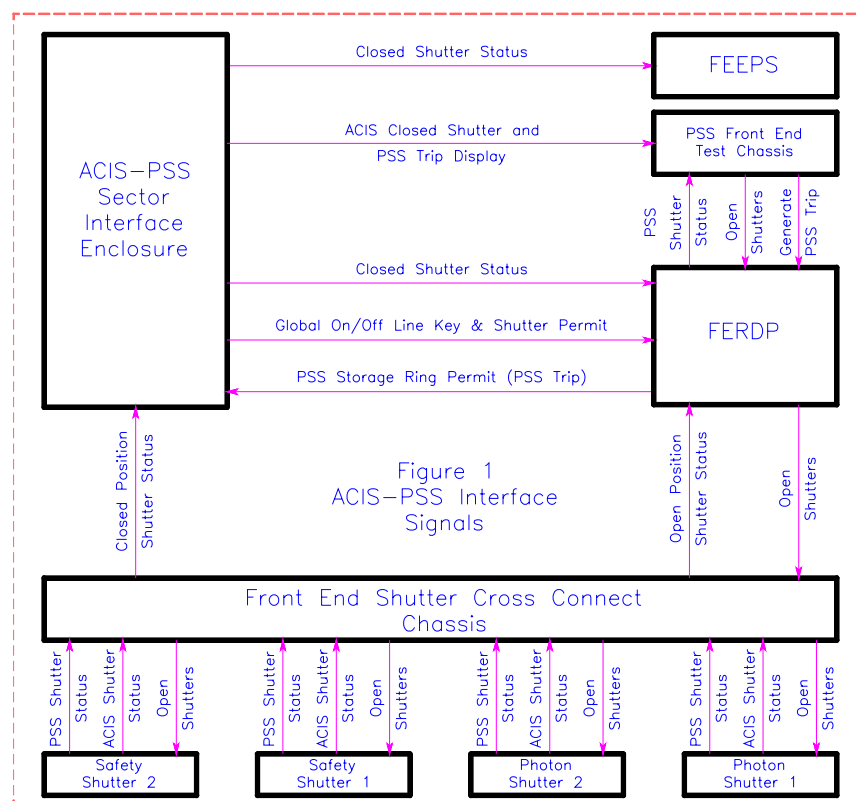
PSS Drawing Nos. 4104-212015, 4104-212016, 4104-212017, 4104-212018.


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## 4. OVERVIEW OF EQUIPMENT

The beam line's front end shutters are the devices that protect personnel working in the beam line stations from radiation generated in the APS's Storage Ring. These shutters are monitored by both the Storage Ring's Access Control and Interlock System (ACIS) and the individual beam line's Personnel Safety Systems (PSSs). In addition to monitoring the status of the shutters the PSSs also enable their operation. Safety functions are performed through redundant Programmable Logic Controller (PLC) based interlock chains (chains A and B) of the ACIS and PSS.

Figure 1 illustrates the configuration of these interfaces and the signal paths. The major components are four shutters (two photon shutters designed to stop primary x-ray beam and two safety shutters that block bremsstrahlung radiation), the Front end Shutter Interface Enclosure (FESIE), the ACIS Sector Enclosure (AES), the Front End Relay Distribution Panel (FERDP), the Mezzanine PSS Test Chassis (MPTC), and Front End Equipment Protection System (FEEPS). With the exception of the FEEPS, these components and their signals are under strict safety system configuration control. The following describes the specific interface between the ACIS and the PSS. Other signals that are not directly related to the ACIS-PSS interface (such as shutter control commands) are discussed for clarity.



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#### **4.1. PHOTON SHUTTER 1 (PS1)**

Photon Shutter 1 is designed to stop primary x-ray beam when it is closed. It is monitored by both ACIS chains (closed position) and both PSS chains (open position). The ACIS does not use PS1 in its protection logic, however, it passes the closed position status to the PSS..

#### **4.2. PHOTON SHUTTER 2 (PS2)**

Photon Shutter 2 protects the beam line from primary beam when the stations are not secure. It is monitored by both ACIS chains (closed position) and both PSS chains (open position). The PSS also allows the photon shutter to be opened when conditions are safe to do so. \*\*\*\*\*

#### **4.3. SAFETY SHUTTER 1 (SS1)**

Safety Shutter 1 is the first of two shutters that protect the beam line from bremsstrahlung radiation. It is monitored by both chains of the ACIS (closed position) both chains of the PSS (open position). The PSS also allows the shutter to be opened when conditions are safe to do so.

#### **4.4. SAFETY SHUTTER 2 (SS2)**

Safety Shutter 1 is the second of two shutters that protect the beam line from bremsstrahlung radiation. It is monitored by both chains of the ACIS (closed position) both chains of the PSS (open position). The PSS also allows the shutter to be opened when conditions are safe to do so.


#### **4.5. SHUTTER CONFIGURATION CONTROL**

Because the shutters are the only protection of the beam lines from Storage Ring beam and radiation it is vital their operation is confirmed. Therefore strict configuration control measures are mandated through administrative control procedures and physical protection. Physical configuration control is provided by the installation of clear covers over each shutters monitoring switch assembly. The mounting screws of the covers are covered by "tamper labels". If the labels are missing or damaged, it must be assumed that work has been performed on shutter's monitoring switches and the position calibration or interface wiring is suspect. Before stored beam operation is allowed the correct operation of the shutter (including chain independence) must be confirmed.

#### **4.6. FRONT END SHUTTER INTERFACE ENCLOSURE (FESIE)**

This enclosure is installed in the Storage Ring tunnel near the front end shutters. It is the cross connect point between the shutter status switches and shutter control actuators and the ACIS Sector Interface Enclosure (ASIE) and Front End Relay Distribution Panel (FERDP) installed on the mezzanine.

Local control of the shutter is provided through this enclosure by use of a hand-held control box. This box is only active when a key switch is activated on the enclosure.

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To facilitate efficient maintenance and testing, an audio communication link is provided between this enclosure and the ASIE.

#### **4.7. ACIS SECTOR INTERFACE ENCLOSURE (ASIE)**

This enclosure is located on the mezzanine on the end of the bending magnet beam line's racks above the ratchet door. It contains hardware for interfacing the ACIS to the bending magnet and insertion device beam lines. In addition to the beam line interfaces, it is the terminus for other ACIS components such as the ratchet door monitoring switches, Beam Shutdown Buttons, Radiation Monitors, and Beam Shutdown Stations and the ACIS PLC's remote I/O blocks.

The enclosure contains isolation relays used to interface to the PSS and FEEPS. There is also a control panel containing the Global On/Off Line Keys for the bending magnet and insertion device beam lines plus various test toggle switches used as part of the ACIS validation.

#### **4.8. FRONT END RELAY DISTRIBUTION PANEL (FERDP)**

The FERDP is located in a group of racks on the mezzanine above the front end section of the respective beam line. It is the interface for the mezzanine PSS equipment including the PLC processors, local I/O modules, beam line front end shutters and ACIS.

#### **4.9. FRONT END EQUIPMENT PROTECTION SYSTEM (FEEPS)**

The FEEPS is located in the same group of racks on the mezzanine as the FERDP. It contains the hardware to provide equipment protection of the front end components. The FERDP received closed position status of the shutters from the ACIS (Chain A only) and open position status of the shutters from the PSS. It is not part of the personnel safety system and not under the same configuration control requirements.


#### **4.10. MEZZANINE PSS TEST CHASSIS (MPTC)**

This chassis is used as part of the ACIS and PSS validations to verify the operation of the interfaces between the systems. It allows individual operation of each front end shutter regardless of the state of the PSS and can generate PSS trips (removal of the Storage Ring permits by the PSS).


Because this chassis can override PSS protection, extraordinary care must be taken into its design so that no personnel are endangered by its use or that stored beam is not inadvertently lost. Consequently all functions require the presence of a key to operate. Normally this key is captured as part of the RF Area ACIS. When it is removed the Storage Ring Controlled Equipment (RF Amplifiers, RF Modulators, and Dipoles) are disabled. An additional safeguard requires the Global On/Off Line key be On Line before the key switch is recognized.

The chassis contains the following hardware:

1. Two position key switch (key is captured in the active position).

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2. Five momentary action push buttons (one for each front end shutter and one to generate the PSS trip.
3. Display LED's driven by each PSS PLC chain for:
  - a. PS1 open
  - b. PS1 closed
  - c. PS2 open
  - d. PS2 closed
  - e. SS1 open
  - f. SS1 closed
  - g. SS2 open
  - h. SS2 closed
4. Display LED's driven by each ACIS PLC chain (future implementation) for:
  - a. PS2 closed
  - b. SS1 closed
  - c. SS2 closed
5. Display LED's driven by contacts in the ASIE for the Global On Line key status and the PSS trip status.

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## 5. SIGNAL DEFINITIONS

### 5.1. PS1 OPEN

#### Description

Asserted "On" equals the shutter is fully open and the open position limit switch is activated. The signal is directly monitored by both PSS chains.

#### Routing

Photon Shutter 1 to the FESIE, passed through to the FERDP.

#### Responsibility

Design (switches, assembly, wire conduits): APS ASD SI Group.

Cable and wire terminations: APS ASD SI Group

#### Operation

This signal is used by the PSS and FEEPS and is described in their applicable documents.

### 5.2. PS2 OPEN

#### Description

Asserted "On" equals the shutter is fully open and the open position limit switch is activated. The signal is directly monitored by both PSS chains.

#### Routing

Photon Shutter 1 to the FESIE, passed through to the FERDP.

#### Responsibility

Design (switches, assembly, wire conduits): APS ASD SI Group.

Cable and wire terminations: APS ASD SI Group


#### Operation

This signal is used by the PSS and FEEPS and is described in their applicable documents.

### 5.3. SS1 OPEN

#### Description

Asserted "On" equals the shutter is fully open and the open position limit switch is activated. The signal is directly monitored by both PSS chains.

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#### Routing

Photon Shutter 1 to the FESIE, passed through to the FERDP.

#### Responsibility

Design (switches, assembly, wire conduits): APS ASD SI Group.

Cable and wire terminations: ASS ASD SI Group

#### Operation

This signal is used by the PSS and FE-EPS and is described in their applicable documents.

### 5.4. SS2 OPEN

#### Description

Asserted "On" equals the shutter is fully open and the open position limit switch is activated. The signal is directly monitored by both PSS chains.

#### Routing

Photon Shutter 1 to the FESIE, passed through to the FERDP.

#### Responsibility

Design (switches, assembly, wire conduits): APS ASD SI Group.

Cable and wire terminations: ASS ASD SI Group

#### Operation

This signal is used by the PSS and FE-EPS and is described in their applicable documents.



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Name	Routing			Description	Responsible Group
	from	to	to		
PS1 Open	PS1 Shutter	FESIE	FERDP	ON = PS1 Open limit switch activated	1
PS2 Open	PS1 Shutter	FESIE	FERDP	ON = PS2 Open limit switch activated	1
SS1 Open	SS1 Shutter	FESIE	FERDP	ON = SS1 Open limit switch activated	1
SS2 Open	SS2 Shutter	FESIE	FERDP	ON = SS2 Open limit switch activated	1
PS1 Closed	PS1 Shutter	FESIE	ASIE	ON = PS1 Closed limit switch activated	2
PS2 Closed	PS1 Shutter	FESIE	ASIE	ON = PS2 Closed limit switch activated	2
SS1 Closed	SS1 Shutter	FESIE	ASIE	ON = SS1 Closed limit switch activated	2
SS2 Closed	SS2 Shutter	FESIE	ASIE	ON = SS2 Closed limit switch activated	2





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Name	Routing			Description	Responsible Group
	from	to	to		
Control PS1	FERDP	FESIE	PS1 Pneumatic Actuator	ON = PS1 Pneumatic controller activated	2
Control PS2	PS1 Shutter	FESIE	PS2 Pneumatic Actuator	ON = PS2 Pneumatic controller activated	3
Control SS1	SS1 Shutter	FESIE	SS1 Pneumatic Actuator	ON = SS1 Pneumatic controller activated	3
Control SS2	SS2 Shutter	FESIE	SS2 Pneumatic Actuator	ON = SS2 Pneumatic controller activated	3

Responsible Group	Name
1	ASD-SI-PSS
2	ASD-SI-ACIS
3	ASD-ME